# ROOFIE DETECTING CUP: DATE-RAPE DRUG DETECTOR WITH AN SMS DEVICE

**A Quantitative Research Presented to**

**The Senior High School Department**

**Malayan Colleges Mindanao**


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**Aretano, Juliano J.**

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In Partial Fulfillment
Of the Requirements for the
Practical Research 1 Course

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# CHAPTER 1

# INTRODUCTION

## Background of the Study

Mike Abramson created the “DrinkSavvy” brand with cups, straws, and stirrers with an added feature to detect rohypnol, gamma-hydroxybutyrate (GHB), and ketamine which are the popular date rape drugs used by sexual predators (Popovich, 2013). His cup product is hard to distinguish from normal cups and that’s the point, it can change color if it detects a date-rape drug and alerts the consumer discretely. Abramson collaborated with two professors to develop a special type of plasticware that changes color if it detects rohypnol, gamma-hydroxybutyrate (GHB), and ketamine, applied it to his products and created the brand “DrinkSavvy”. In all similar studies we have read lots of different products with the same function; it detects date-rape drugs such as rohypnol, gamma-hydroxybutyrate (GHB), and ketamine, but the inventors only stopped from there. Similar cup products only had a special type of plasticware that changes color when it detects date-rape drugs, but it can be improved if a device picks up on the detection of the drugs and alerts the establishment. Possibilities will happen that a drink has been spiked but the consumer will still become a rape victim, and the reason why is because the consumer might be the only one informed that his/her drink has been spiked. People with proximity to the consumer might not know that he/she has been drugged, and that’s how we thought that a date-rape drug detecting cup must have a device that informs the establishment that their

customer is becoming a victim to a sexual predator and an SMS device inside the cup is our best choice to prevent this unfortunate situation.

Still to this day, rape is a crime that is still committed and yet looked over by authorities. According to World Population Review (2022), most cases of rape not being reported may include embarrassment from both victimizer and victim, fear of any reprisal from the rapist, and fear of the victim's family's reaction to the situation. Hughes et al. (2011) of Flinders University conducted a study that detects gamma-hydroxybutyrate (GHB) and shows the obstacles in detecting the drug. Their newly developed method utilizes ion-exchange chromatography with conductivity detection of GHB anions and chloride. This method had a faster detection of GHB compared to the current gas chromatography-mass spectrometry technique which identifies substances in a test sample.

In a statement by the Philippine Drug Enforcement Agency, the Philippines has now listed Gamma-Butyrolactone (GBL) as a dangerous drug. This is a liquid compound used as a solvent and sometimes taken as a recreational drug, which is being metabolized by the body producing an active substance called the Gamma-Hydroxybutyrate (GHB)- which is another compound that has a high potential for abuse (Philippine Drug Enforcement Agency, 2019). In relation, a study that was conducted by Narang, Singhal, et.al. (2018), they developed a naked-eye assay- evaluation- that can detect the presence of date-rape drugs in alcoholic beverages. This device is then connected to a smartphone app, which allows the person with the phone to know whether the beverage is safe or unsafe to drink. It also sends a message to a selected number, if the person is in danger.

Statistics show that the number of reported crimes involving illegal drugs in the Philippines has grown to approximately 62,000 in the year 2020 (Statista, 2021).

The research conducted by Evans, B.S. et. al. (2021), presents the development and design of a smart fire monitoring system for a city. The smart fire alarm device utilizes electrical components, sensors, Agile Prototyping Methodology (APM), and employs Agile Software Development Methodology (ASDM) for the development of the Smart Fire Monitoring System Software (SFMSS). The SFMSS will continuously communicate with the devices allowing the system to send timely SMS notifications. Its fundamental principle is similar to our capstone research since it sends an alert to the establishment with the utilization of SMS notifications.

**Project Objectives**

This capstone project aims to achieve the following objectives at the end of the course:

1. To design a Roofie Detecting Cup with an SMS Device that notifies the establishment if a drink has been spiked.
2. To test the Roofie Detecting Cup with an SMS Device in terms of its:
    a. Functionality of the detection of date-rape drugs and the SMS Device
    b. Performance of the Detection of Rohypnol, Gamma-hydroxybutyrate (GHB), and Ketamine
    c. Performance of SMS Device in alerting the establishment

3. To lessen the rate of rape victims being drugged by sexual predators through the Roofie Detecting Cup.

**Significance of the Study**

The researchers' Roofie Detecting Cup: SMS Device is a revolutionary product that will save victims from sexual predators. Our simple addition of an SMS Device might seem too simple, but getting the attention of the establishment will be a major factor in preventing an unfortunate situation, the victim being raped. Other than the possible victims of sexual predators, the following are the beneficiaries of the researchers' product:

*Future Researchers.* This will be beneficial to future studies that involve the detection of rohypnol, gamma-hydroxybutyrate (GHB), and ketamine. It will also help future studies related to SMS chips that alert devices.

*Club Attendees.* They are people who visit clubs and bars and are the targets of sexual predators inside beverage establishments. With the Roofie Detecting Cup, they will feel safer in these kinds of establishments as they do not have to worry about being spiked.

*Beverage establishments.* Examples of beverage establishments are clubs and bars, where most alcoholic drinks are sold every night. They will benefit from our product because if they endorse it in their establishments, customers will feel a lot safer bringing more profit as customers will enter beverage establishments more frequently.

*Police Authorities.* The police are responsible for making decisions in situations that involve crimes and apprehending violators. The police can benefit from the Roofie Detecting Cup because the product can alert the establishment and they can apprehend sexual predators, stopping them from committing serious crimes in the future.

**Scope and Delimitation of the Study**

This research study aims to design a Roofie Detecting Cup with an SMS Device to lessen the rate of rape victims caused by date-rape drugs such as rohypnol, gamma-hydroxybutyrate (GHB), and ketamine. It will only detect the three drugs mentioned as it is the most used drugs by sexual predators to rape victims. It also aims to create an SMS Device that alerts the establishment if a drink of their customer is being spiked. A pushbutton will be used to activate the Device and must be pressed manually by the consumer in sending an SMS to the establishment. This study will investigate how to detect rohypnol, gamma-hydroxybutyrate (GHB), and ketamine, and how to design an SMS Device with a fast response time that can alert the establishment immediately.

The project will be conducted limitedly at the Malayan Colleges Mindanao during the academic year 2021-2022. The institution is equipped with facilities that can assess the certain needs of the researchers. The idea compiled by the researchers started in January up until May 2022. The respondents of the study will be adults with ages ranging from 20-30 years old, as their age group frequent beverage

establishments and sample population will be picked from Davao City. This research will be conducted using the quantitative method as its approach since it dwells more on statistics. The research design will be experimental since our product will need more depth in chemistry and SMS technology. Our study will use online surveys for gathering data since the research approach is quantitative and to measure the frequency of malicious situations involving date-rape drugs in beverage establishments.

# CHAPTER 2

## REVIEW OF RELATED LITERATURE AND SYSTEM

This section will cover the related literature regarding the existing Roofie detecting devices and devices that alert the user using SMS technology. It will present the features of the projects, their usability, and the concerns that arose while using these systems. System development tools will be discussed and how their application can improve Roofie detecting systems. This project will also discuss the five related systems associated with the developers' capstone project as well as the theoretical and conceptual framework to help the project's intention more understandable. Multiple terms will be given definition to give clarity of the content. The developers have amassed several studies, articles, and reliable data to help in grasping the concept of the project and envisioning the product's features and applications.

### Related Literature

The developers gathered related literature concerning the significant variables of the Roofie Detecting Cup: An SMS Device Detecting Date-Rape Drugs Against Sexual Predators. This segment has been divided into four themes: date-rape drugs, utilization of date-rape drugs in a sexual assault, application of

Zimmermann Reagent, and SMS device. To give a better understanding of how date-rape detecting devices work, we have gathered significant data and will discuss the features of the system used by similar products.

*Date-Rape Drugs*

Date-rape drugs such as rohypnol, gamma-hydroxybutyrate (GHB), and ketamine are used to render a victim unconscious (Casarella, 2020). Rohypnol, also known as flunitrazepam, is part of the family of benzodiazepines that are used to lower brain activity. Rohypnol is a tablet that can be consumed directly or can be dissolved in beverages by powdering it first. When it is mixed with a beverage, it often results in blue color, but sexual predators cover it by using blue-colored drinks (National Drug Intelligence Center, 2006). Rohypnol or flunitrazepam is normally a central nervous system depressant which if ingested with alcohol, creates an amnesia effect where the person won't be able to recall any memory of any sexual assault being done to them. The drug may also be called *roofies* (University of Michigan Health, 2020).

The date rape drug Gamma-hydroxybutyrate (GHB), also known as sodium oxybate, can make a person feel relaxed or perhaps playful when ingested in small doses but may become lethal when overdosed. Side effects from overdosing on GHB may include dizziness, drowsiness, and may at some point lose consciousness, which is why the substance is used in many date rapes or crimes. According to the World Health Organization (2012), GHB is a central nervous system depressant found in many animals but in only a small amount. It can also be made synthetically from gamma-butyrolactone (GBL) and by adding lye in

ethanol or water. GHB was approved by the Food and Drug Administration (FDA) in July 2002 as a drug to treat cataplexy of narcoleptic patients (Fuller & Hornfeldt, 2003).

*Utilization of Date Rape Drugs in Sexual Assault*

Sexual assault by a stranger is becoming more common among young women and teenagers. The use of drugs to induce amnesia and quick drowsiness of the victim is becoming increasingly widespread. Many have been raped while drunk or drugged with the act of using Date-Rape Drugs. Depending on the amount ingested, the person will have no recollection of what transpired while under the influence. Within just a few minutes, these drugs can cause dizziness, slurred speech, lack of muscle control, sleepiness, loss of consciousness, or even death. In contrast to previous cases, women's voluntary drug use before a sexual attack reduced the offender's accountability and blame while increasing victim blame (Sandal, 2020).

In the utilization of Date-Rape Drugs, the most discovered substance was alcohol. Cannabis and benzodiazepines were also frequently found, but lack of background information made it difficult to determine how much they contributed to probable Drug-Facilitated Sexual Assault or DFSA cases. Alcohol was also the most common substance discovered in a second study, accounting for 30.9 percent of the 1,000 reported DFSA cases examined. Alcohol use significantly increases DFSA risks since it is much easier to drug someone during this kind of situation. (Florentin & Logan, 2019).

*Reactants of Date-Rape Drugs*

The Zimmermann reagent is a drug testing equipment that is utilized in chromatography to detect benzodiazepines (a class of psychoactive drugs) and other compounds (Rohypnol and Ketamine). The Zimmerman reagent took its name after Robert Zimmermann, an American Botanist. Furthermore, it is compromised with two components. The first component is containing 1, 3-dinitrobenzene in methanol, while the second component is containing 15% of potassium hydroxide in water. The two components are added to the sample by pouring a single drop of each component, then there will be a change of color to the sample that will indicate the identity of the compound (DBpedia, n.d.).

According to PRO Test (2020), it is noted that the Zimmermann reagent is only able to detect the presence of the substance and not the possible quantity of said substance, nor will the speed of the reaction be relevant. To apply the reagent, it involves a two-part test which includes Reagent A and Reagent B that will be mixed. In a test tube, a drop or 2 drops of each reagent will be added, the initial color of the resultant liquid appears chalky white after being gently swirled. The substance will be added next into the liquid mixture, mixed gently with applied little heat as it is swirled, results will come in as the reagent has changed its pigment depending on which substance was added.

Pazdziorek et al. (2006), developed a method to detect GHB and this method of making a narcotics detection test involves mixing 2 to 5 parts by mass of bromocresol green with 100 to 180 parts by mass of amine salts, 150 to 210 parts by mass of sugar, 3000 to 6000 parts by mass of water, and 18000 to 26000

parts by mass of alcohol, and bringing the solution to a pH of 1 to 4 with a nonvolatile acid. 1 to 2 parts by mass of methyl orange are preferred in the procedure according to the present invention. Furthermore, a main aliphatic amine salt, preferably diethylamine dihydrochloride, is utilized. Glucose may be employed as the sugar, methanol, or ethanol as the alcohol, and citric acid as the non-volatile acid in the technique according to the present invention. 0.05 to 0.25 ml of the solution prepared using the method described in the present invention is transferred to a surface that is inert to the solution and dried at a temperature below 60°C.

Cobalt Thiocyanate is a reagent utilized in a test usually for cocaine, however, Cobalt Thiocyanate also reacts with other drugs. Moreover, this test is called the *Ruybal Test.* When the reagent is exposed to the existence of cocaine, the reagent will react and form an insoluble ion pair. There are similar varieties of tests performed. In the first test, a dissolving cobalt thiocyanate in dissolving is prepared for the reagent and added with other ingredients that are ammonium thiocyanate. Then, the dissolving thiocyanate is added to cocaine powder. When both components are combined, a blue precipitate was formed (Bell, 2013).

*SMS Device*

Short messages service (SMS) delivers messages from one mobile to another. The delivery process of short messages starts from storing the message in a central short message center (SMS) coming from the sender, then it is forwarded to the desired destination mobile. The storing of the short message benefits the delivery process given that there are contexts that the recipient shows

unavailability. In such a context, the short message stored can be sent later when the recipient. The short message stored can be sent later when the recipient is available in sin such a context is available. The SMS service can be utilized as a notification system (Katankar & Thakare, 2010).

*NFC Tag*

To distinguish the cup of the customers so we can identify who was roofied, we need an identification tag for each cup. Near-Field Communication (NFC) Technology is a technology branched from Radio Frequency Identification (RFID). NFC works similarly to RFID, but it's a more intimate kind of wireless. NFC readers have a maximum range of roughly 4 inches; however, RFID readers may be utilized from a distance (10 centimeters). The range of NFC scanners is insufficient for RFID-style inventory tracking. As a result, NFC tags are employed in numerous applications where the ability to instantly transmit a few bits of digital data is useful (Chandler, 2021). We will use an NFC tag to identify the cups when a cup sends a message that its drink has been drugged.

## Related Systems

This section presents the existing related systems to our study that may serve as a guide in this study.

**Abramson et. al. (2014), System and Method for Detection of a Contaminated Beverage, US8920857B2**

The invention developed in the United States of America made by Michael Abramson is a cup with a special lining that detects date-rape drugs. The cup will react visibly when it detects rohypnol, gamma-hydroxybutyrate (GHB), gamma-butyrolactone (GBL), ketamine, and 1,4-butanediol, changing its color and informing the consumer that their drink is spiked. It has a wax film where a reagent that detects the date-rape drug is placed, and a reagent will change its color if it detects a date-rape drug in 30 seconds or less. The wax film is divided into sections to detect the four date-rape drugs. It benefits club attendees as this product could prevent them from being rendered unconscious and be assaulted physically and sexually. This product is used to determine the presence of four date-rape drugs, rohypnol, gamma-hydroxybutyrate (GHB), gamma-butyrolactone (GBL), ketamine, and 1,4-butanediol discretely. The material of the cup is made up of plastic and the insides of the wall of the cup is made up of polymer. A wax film is applied to the cup and separated into four sections.

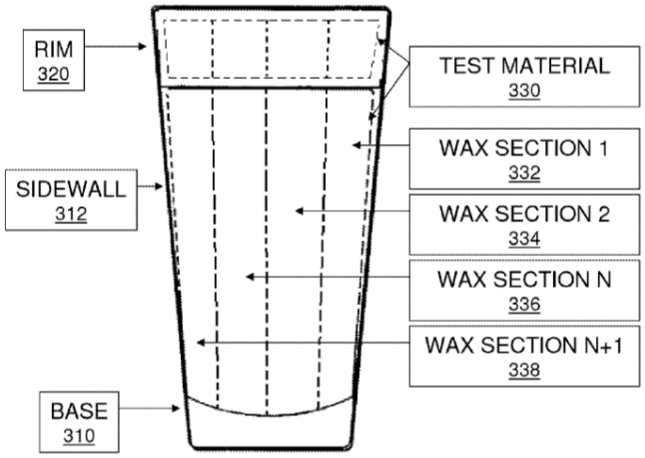


*Figure 1. Abramson et. al. (2014), System and Method for Detection of a Contaminated Beverage, US8920857B2*

**Bradley, M. et al (2012), Drug Detection Device, US20120070901A1**

From the country of the United States of America, the Drug Detection Device takes in the form of a straw or a stirring straw that a person could use when going out to pubs or night outs. The straw is coated with a reagent that could change the pigment or the color of the straw when in contact with drugs, specifically date rape drugs, in a drink. The device is said to be practical and reusable on any occasion, as it can be used at any time and place, while also being able to be used more than once. For this project, a group of local chemists and those who study medical science will help contribute to developing the chemical reagent that is set

to react to any date rape drug upon contact. Factory managers would also contribute to making the straw itself, and how it would implement the reagent on its surface, while also maintaining its practicality in use. The purpose of having a chemical that changes the color of the straw is to alert the person that is using it that their drink has been spiked or laced with a date rape drug. Due to its practicality and its simplicity in use, it is easy to detect if their drink or someone else's drink was spiked with a drug using the device. Being able to detect a spiked drink could save a person from any harm or predicament of anyone taking advantage of a drugged victim, especially those using the opportunity to rape the person that has been drugged. The straw itself would be made with durable material and less fragile to lengthen its use. Whilst having a durable and reusable material, it should still be able to have the chemical reagent integrated to be able to show its effectiveness.

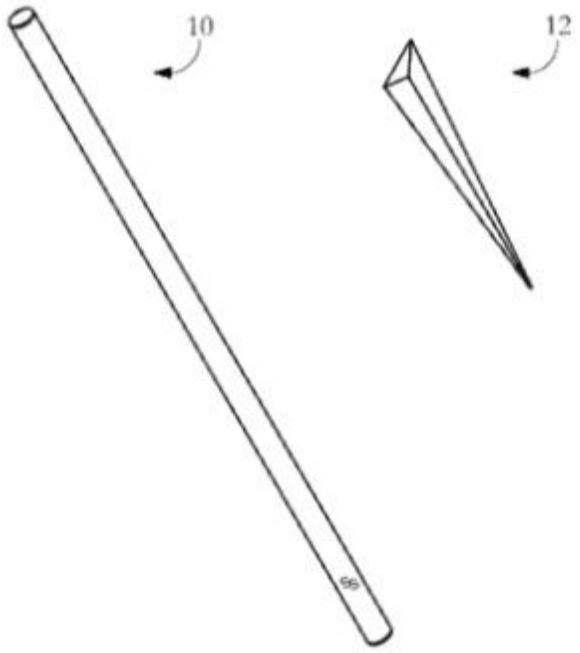


*Figure 2. Bradley, M. et al (2012). Drug Detection Device. US20120070901A1*

**Letourneau, Khalifa, et.al. (2017), Wearable Apparatus for Detecting a Target Substance in a Liquid, US10016315B2**

The invention developed in Australia makes up of a detection layer comprising an indicator that is configured to display a signal when detected interaction with the targeted substance. The wearable apparatus could be a fingernail that detects illicit drugs in a beverage. This can be used for real-time detection of targeted substances like ketamine, 4-hydroxybutyric acid (GHB), ephedrine, methamphetamine, amphetamine, flunitrazepam, 3,4-methylenedioxymethamphetamine (MDMA): also known as ecstasy or molly, tetrahydrocannabinol (THC), benzodiazepines such as clonazepam, and others. The ones who would benefit from this would be, first, are the customers of

beverage establishments such as pubs and bars, as this is where most sexual predators find their prey. They would be able to become aware of their surroundings and the drinks they bought. The authorities would be the second beneficiary. As the product would alert the person himself, this allows them to report the incident to the authorities and apprehend the suspects. The goal of this product is to easily alert the user or drinker to the presence of any of the date rape drugs, as aforementioned, in an unsuspecting drink. The device conforms to any suitable objects like a fingernail to detect traces of date rape drugs in a beverage. The device includes protection against the external environment, a detection layer, which comprises at least one matrix that includes a marker, lateral flow assay, a nanofluidic device, a microfluidic device, and an electrochemical sensor or a membrane.

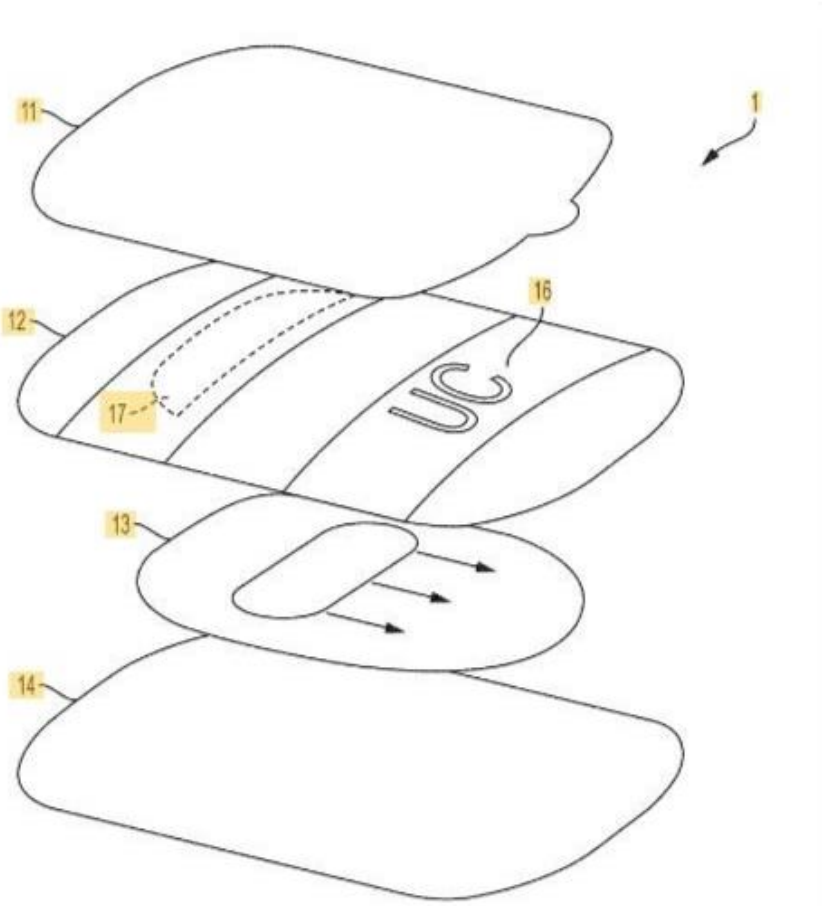


*Figure 3. Letourneau, Khalifa, et.al. (2017), Wearable Apparatus for Detecting a Target Substance in a Liquid, US10016315B2*

**Holmes (2014), Nonvisual Indication of an Unwanted Chemical in an Ingestible Substance, AU2014221225A1**

The invention developed in Australia exhibits the methods and systems for detecting the presence of undesirable substances (such as date rape drugs) in ingestible substances, this includes solid, semi-solid, and liquid indigestions. Furthermore, the date rape drugs include flunitrazepam (trade name ROHYPNOL, and street name "roofie"), gamma-hydroxybutyric acid (or GHB), and ketamine.

The methods and systems specifically suggest a non-visual verification method, in other words, the process of indication and detection of the presence of undesired drugs is done concealable to avoid the suspected individual knowing that they are under suspicion of tampering with food or beverage. Moreover, aside from the present invention stated, there are three selected embodiments. The three selected embodiments are summarized through the flowcharts presented below (Fig. 1, Fig. 2, & Fig. 3). Looking in Fig.3, the present invention takes almost the same characterizations as of the third selected embodiment (Fig. 3). Additionally, the difference between the third selected embodiment and the present invention is that the third selected embodiment is characterized as a non-visual verification system, whereas the present invention is characterized as a non-visual verification device.

The invention utilizes a sensing component. The sensing component will enable the system to bind the target substance results directly or indirectly in a non-visual response. Also, it may be as simple as a molecule or a molecular array that incorporates one or more binding sites that are complementary to the target substance. Furthermore, the invention also incorporates an indicating component that indicates the user via non-visual indication. The indicator substance will be used by placing it inside the user's mouth. The indicating component will produce a non-visual response such that is a flavor to indicate if there is a presence of an undesired drug in the indigestible substance. The indicating component may be present on a strip of paper, a dissolvable strip of material, a saliva-dissolvable material, or a chewing gum-type of material.

The present invention benefits individuals who may turn out to be unsuspecting victims of sexual assaults or other abuses with the utilization of date rape drugs. With the utilization of date rape drugs, facilitating sex assaults or other abuses would be easier for the assailants as the victim will be in a state of vulnerability while they are drugged. Moreover, using the present invention illustrated in the patent will enable the individual in assessing if the ingestible food or beverage has tampered with unwanted drugs. In a context that unwanted drug/s is/are detected, the user would be indicated with a non-visual response from the device so that he/she would be aware of the situation he/she is in.

With the non-visual indication feature of the invention, the user will not be suspected of being suspicious of the ingestible food or beverage. This unique feature will help the user to escape if he/she is placed in an unfortunate situation since the indicator will indicate a non-visual response making the assailant be unaware that the targeted victim is indicated that the ingestible substance has been drugged. The user can act out of the situation conceivably enabling him/her to cautiously get away from the situation.

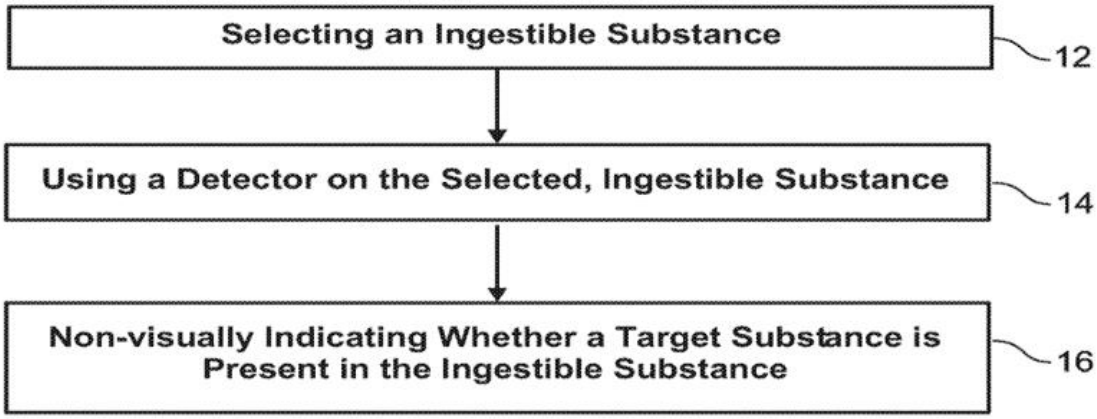


*Figure 4. Holmes (2014), Nonvisual Indication of an Unwanted Chemical in an Ingestible Substance, AU2014221225A1*

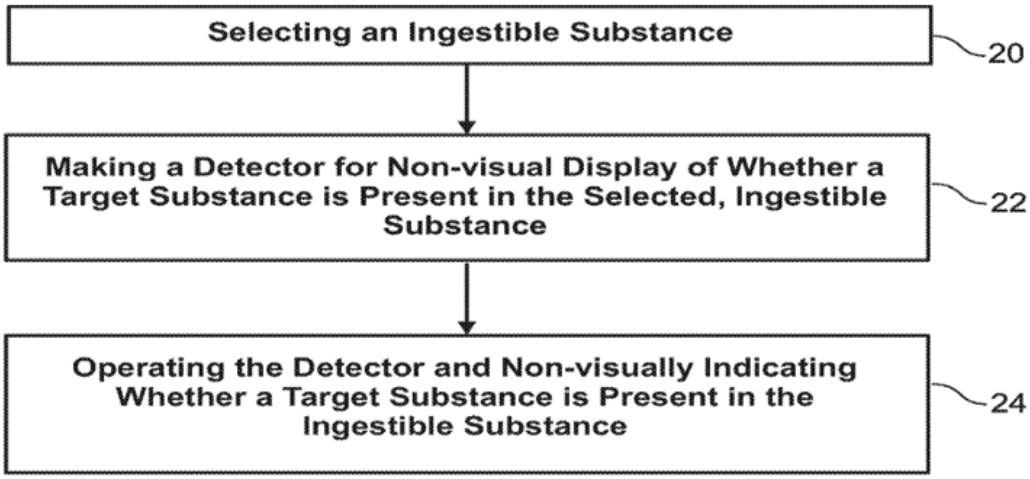


*Figure 5. Holmes (2014), Nonvisual Indication of an Unwanted Chemical in an Ingestible Substance, AU2014221225A1*

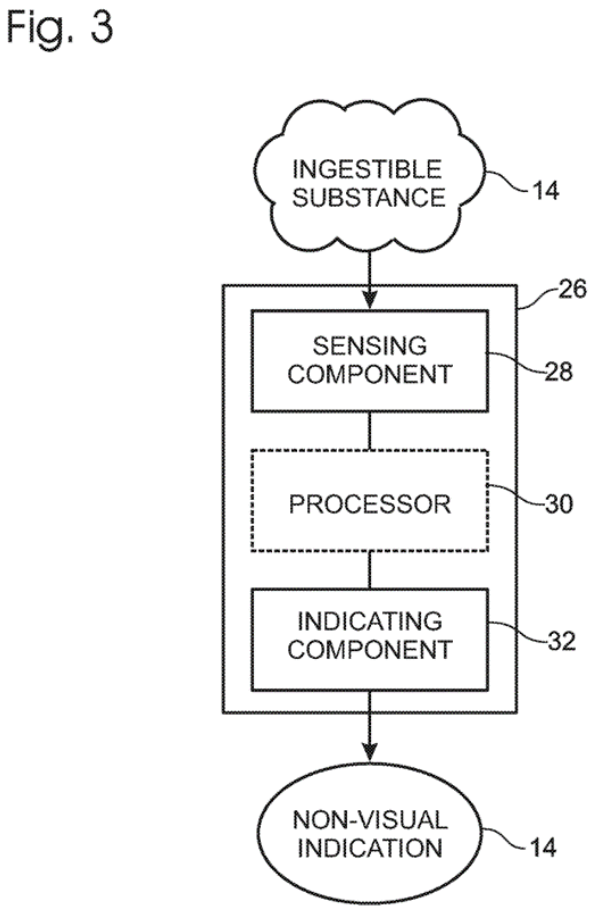


*Figure 6. Holmes (2014), Nonvisual Indication of an Unwanted Chemical in an Ingestible Substance, AU2014221225A1*

**Schindler, et. al. (2007), Testing Strip and Dispenser, US51624206A**

From the United States of America, his product has a testing strip with a strip carrier that has a reagent on the strip carrier. Three of these tools are put in a container. Rohypnol, gamma-hydroxybutyrate (GHB), gamma-butyrolactone (GBL), ketamine, and 1,4-butanediol can be detected using the reagent and the strip will change color if the mentioned drugs are detected by the reagent. The

testing strip can be disposable, and this product can detect multiple date-rape drugs in one test. The container has a mechanism that takes the testing strip in and out of the container. It benefits club attendees as this product could prevent them from being rendered unconscious and be assaulted physically and sexually. This product is used to determine the presence of four date-rape drugs, rohypnol, gamma-hydroxybutyrate (GHB), gamma-butyrolactone (GBL), ketamine, and 1,4-butanediol discretely. The material used to create the testing strip is either plastic or cellulose paper. As for the container and the strip carrier, the material used to create it is plastic.

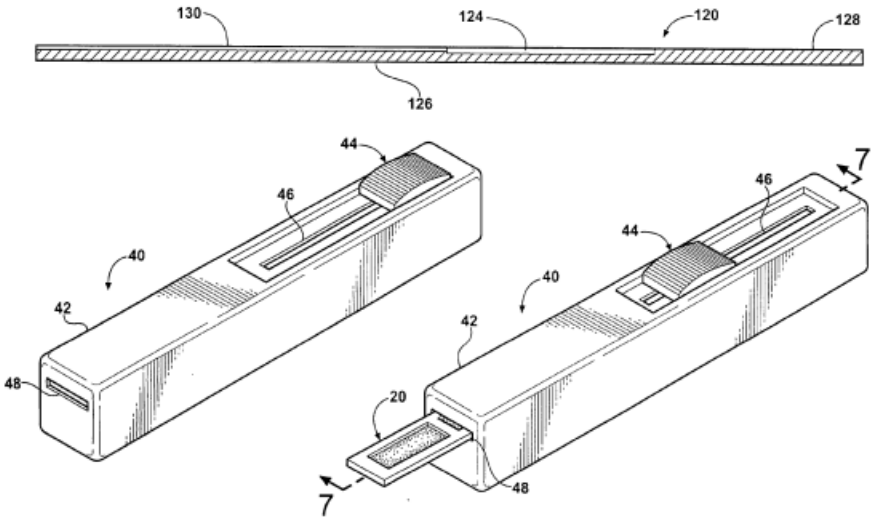


*Figure 7. Schindler, et. al. (2007), Testing Strip and Dispenser, US51624206A*

## Theoretical Framework

The theoretical framework is critical in providing key aspects and theoretical approaches to offer related concepts to the research. Theories are investigated in the context of establishing linkages between concepts for the purpose of understanding and, consequently, drawing conclusions. Social control theory and social Learning Theory are being used in this work to better grasp the basic limitations of our study.

First theory Identified. The Social Control Theory states that Individuals are inherently drawn to satisfaction, self-interest, and transgressive activities, according to social control theory. As a result, rather than addressing the topic of what motivates people to engage in such action, theory must examine why they do not do so (Hirschi, 1969). Individuals are liberated from restraint when the social tie is weakened or severed, allowing them to participate in substance usage associated with illegal practices. As populations grow and fluctuate, group members become less interested in one other's activities, and their capacity to keep track of one another. Because of this, the deviation is becoming less beneficial. This is in line with According to Nock's (1993) reasoning, the quantity of strangers inside a community grows as the population grows. As society evolves, so does the degree of privacy that individuals enjoy. As a result, identities are becoming more difficult to maintain and decipher, making aberrant activity simpler to conceal. Groups are more inclined to implement compliance techniques, such as drug screening and information databases, when certain circumstances exist to

determine a person's integrity and reliability. These strategies aren't reliant on an individual's particular understanding concerning the history of another. Instead, they are impartially directed at large populations, conveniently deployable, and accessible to potential recipients fast.

When adolescence bonds are deep, the youth is more likely to consider parental opinions prior to engaging, reducing the chance of drug usage. The adherence to traditional routes of activity is the second component of a social tie. People who want to attain traditional objectives are less likely to take drugs since doing so may compromise both their quest for those objectives and their previous investments. Many traditional aspirations, for example, necessitate knowledge, therefore school becomes quite important to children. Drug usage is thought to be reduced when students are committed to education. The interdependence of relationships necessitates the involvement of other people. Participants need to be less receptive to misbehavior and, as a result, more accountable. Deviance is more likely to be reported (Kubrin et al., 2009).

This might be especially true in areas with large, shifting populations. As a result of the fact that such situations usually supply a substantial amount of obscurity, the dangers of causing harm to one's reputation. Deviance may be less prevalent, or at the very least simple to handle. compared to communities that are smaller and more stable. As a result, the potential societal costs of detection will be reduced. In conclusion, the smaller the cost of leaving the group, and the more options available, the simpler it is to take advantage of them. Conventional cultural control measures become less successful as a result. As a result, the chance of a

group turning to compliance increases. The number of tactics for detecting deviation should be increased.

Second theory identified. Social Learning Theory's core idea is that substance dependence, like any other behavior, is taught and influenced by the activity's consequences and expected consequences. Social comparison, concepts, replication, and differential reinforcement are four fundamental constructs in Akers' theory. Differential association is the most essential of the four constructs. The people with whom the character is most prone to participate and their relevance to the actor are referred to as differential affiliation. These individuals, by their behaviors and attitudes, influence whether the actor will take drugs (Krohn et al., 2016).

Differential affiliation is the third theory identified. The people with whom the participant would be most likely to engage and their relevance to the actor are referred to as differential association. These individuals, by their behaviors and attitudes, influence whether the actor will take drugs. Differential association is also crucial as it determines the main context wherein the participant can observe others engaging in drug-using behavioral patterns, end up facing a stimulation that increases the likelihood of a future response for repeated drug usages and obtain understandings or behaviors desirable to drug use (Marcos et al.,1986). Overall, the primary assumptions developed from the social cognitive viewpoint have a lot of support. Social learning theory, on the other hand, does not imply that people want to interact with substance abusers or delinquent organizations in the first place. Social control theory offers the ability to bridge this gap.

In such a case, social control and social learning theory contend that reducing the social ties liberates individuals from constraints, allowing them to participate in deviant behavior, but it fails to explain why some people who are less restricted engage in deviant behavior while others do not (Marcos and Bahr 1988). This theory is relevant to the study because it covers characteristics of substance use that are relevant to the study's aims, particularly in terms of comprehending the obstacles that exist within it. As a result, this hypothesis would strongly support our research.

The fourth theory identified is the Technology Acceptance Model, which was developed by Fred Davis and Richard Bagozzi in 1989. It was developed considering the concern that workers at that time were not using information technology (IT) made available to them (Holden & Karsh, 2010). In other words, this is an information systems theory that shows how users come to accept and use technology. This theory can be applied in this study, in a way that the researchers have considered using Short Message Service (SMS) to alert an individual and the establishment that a drink has been tampered with illegally. This supplies another perspective that aside from the detection devices used and approved by the authority, other forms of technology can be applied to this concept.

Nock (1993) stated in his theory that drug use and victimizing other people in sexual assaults stem from the environment of their school, family, and other aspects of society. This theory will help the developers understand why sexual predators exist. Akers and Burgess' Social Learning Theory also helps us to

understand how sexual predators learned their behavior. Their theory states that observing and imitating others can influence the development and growth of a person's attitude and social interaction with others. The Technology Acceptance Model created by Davis & Bagozzi (1989) helps us understand the behavior of future applicants of our project as some may see our project as crude and incomplete but with this theory, the developers will be able to present its usefulness to the buyers and audience.

## Conceptual Framework

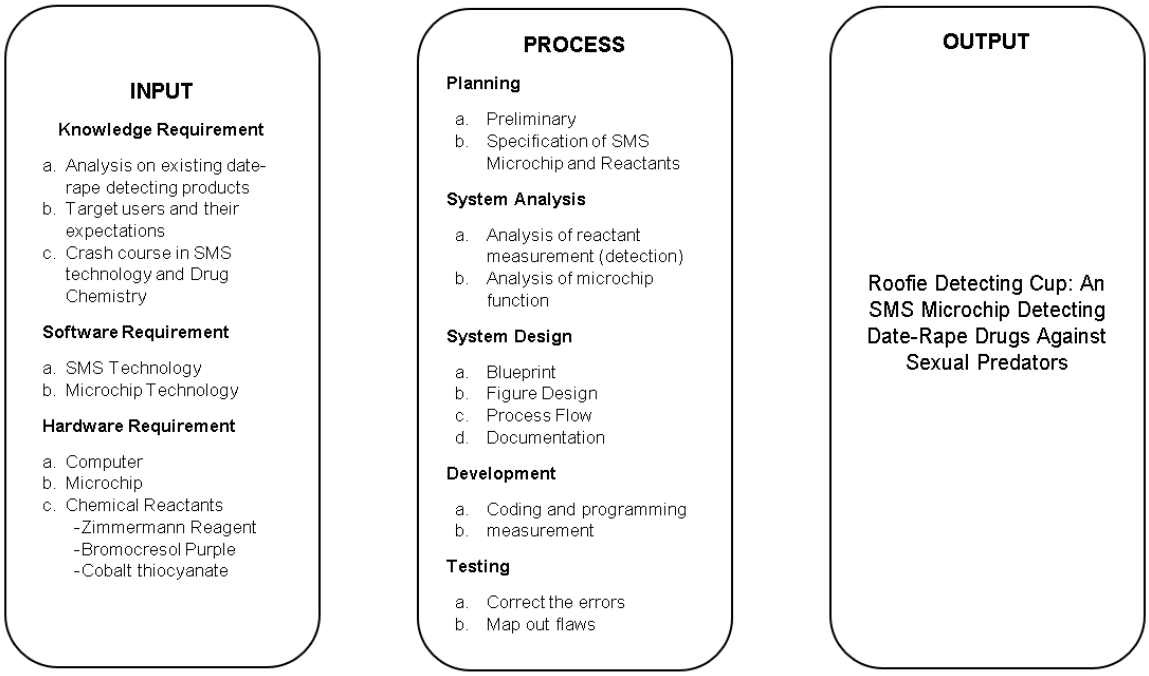


Figure 8 *Input-Process-Output (IPO) Conceptual Framework for Roofie Detecting Cup: Date-Rape Drug Detector With an SMS Device*

The conceptual model for this study will be using the Input Process Output (IPO) Model which shows the developers' synthesis of the gathered data in preparing the stages in this study. This model is divided into three parts: input, process, and output. The input phase will be the representation of the conceptualization of the developers. As for the process phase, it will represent the stages of development of the research study and the primary goal is to be consistent and to be aware of the delimitations. Finally, the output phase will be the endpoint of the process and where the project objectives are finally done.

In the first phase of the conceptual framework, the input has three elements: knowledge requirements, software requirements, and hardware requirements. The knowledge requirements expound the needed information in developing the product such as basic knowledge in SMS technology and Drug Chemistry, the target users and their expectations, and the analysis of similar projects. The software requirements are the programs or software needed to construct the function of the prototype. Lastly, the hardware requirements are the tools and materials needed to construct a physical prototype.

The second phase of the conceptual framework which is the process consists of the preliminary investigation of the study, system analysis, system design, development, testing, and implementation. The preliminary investigation of the study tackles the process of gathering and analyzing related literature about date-rape detecting inventions and SMS devices. The system design defines variables, data, and other related literature to satisfy the requirements in creating the prototype. For the system analysis, we will have to skim similar projects and

analyze their objectives and procedures in creating their prototype design. In our study, we will utilize the iterative model because we will encounter problems in creating the prototype and we will repeat cycles until we reach a satisfiable solution. As for the development, we will use coding and programming for the SMS device and as for the detection of date-rape drugs, we will use measurement in chemistry. The prototype will undergo initial testing to correct its errors and map out its flaws. As for the implementation, we will only deploy a prototype design.

The output, the third phase of the conceptual framework, is the prototype design of our project.

**Operational Definition of Terms**

This section presents the unfamiliar terms in this research that are relevant to this study.

Exchange Chromatography (IEC) - is a common method for separating charged biomolecules such as proteins, peptides, amino acids, and nucleotides. Ion chromatography, along with ion partition/interaction and ion-exclusion chromatography, is an important analytical technique for the separation and identification of ionic substances. Ionic interactions between ionic and polar analytes, ions present in the eluent, and ionic in ion chromatography, functional groups attached to the chromatographic support are used to separate them.

Bromocresol green - is a triphenylmethane dye that belongs to the triphenylmethane family of dyes (triarylmethane dyes). It belongs to the sulfonephthalein dye family, and it's employed as a pH indicator in things like microbe growth media and titrations. It is extensively used as a diagnostic method in clinical practice.

Gamma-hydroxybutyrate – a psychoactive drug that induces extreme energy and increases the sex drive. Its negative effects are loss of consciousness, amnesia, and hallucinations which sexual predators have taken advantage of to victimize club attendees. It can be made in a laboratory or naturally produced in the human body, specifically the central nervous system.

Gas chromatography-mass spectrometry (GC-MS) - is an analytical method used to identify different chemicals in a test sample that combines the characteristics of gas chromatography and mass spectrometry. GC-MS facilitates drug detection, fire investigation, environmental analysis, explosives investigation, and identification of unknown samples. This helps authorities and medical professionals identify the type of chemical used in a crime or accident that occurs.

Ketamine – a drug that is commonly used as a general anesthetic in medicine. It can also be used to sedate and paralyze individuals, and sexual predators use it to rape other people.

Reagent - is a substance or mixture that is added to a system to start or test a chemical reaction. A reagent can be used to determine whether a specific

chemical substance is present by causing a reaction with it. It can also be used to detect or measure a component or to prepare a product.

Roofies – A slang term for Rohypnol but can also be a blanket term for date-rape drugs. It is a prescription benzodiazepine drug, a depressant drug that lowers brain activity and that helps treat anxiety, insomnia, and seizures. The effects of the drug may be felt within a few minutes and can last for several hours. The drug causes you to feel dizzy, tired, weak, confused, and forgetful.

SMS - Stands for Short Message Service or commonly known as SMS. Text messaging has many uses, it is used to communicate and notify people through text messages in our devices. Additionally, it can be used as a tool for alerting and notifying individuals or authorities without using sound.

# CHAPTER 3

# METHODOLOGY

Unfortunate situations such as being drugged or worse, being sexually assaulted while drugged have happened all over the world and must be stopped for the safety of customers of beverage establishments by using date-rape drug detectors and to alert the third person. In addressing this problem, the developers' research methodology covers the research and process model, research locale, and research respondents to present the research approach and model to be used by the research study. The tools that will be used by the developers are presented in the research assessment tool, system development tools, hardware and software requirements of the research study. It will also present the data collection procedure of the study. Lastly, it will show trustworthiness and ethical considerations to support the credibility of our study.

## Research Design and Process Model

The developers' capstone study will use the quantitative research approach which is more on numerical data in giving clarity through multiple theories that employ planning, designs, synthesizing hypotheses, etc. Due to this approach, the study will need more data collection that is measurable in culminating our capstone project. According to Ortlieb (2021), there are four research designs for quantitative research, and they are divided into two: experimental and non-

experimental designs. The developers' study will use an experimental research design that will measure numerical data on the effects of the independent variable on the dependent variable.

The developers will use the Iterative Model. It learns the input that goes into a life cycle that does not have a complete set of needs and concentrates on the first characteristics. As a result, the input will get increasingly sophisticated until the entire set of features of the intended system is complete. This strategy, on the other hand, begins by defining and implementing requirements, which will then be reviewed and prioritized before identifying new software versions for each iteration. It is a looped design with planning, analysis, implementing, testing, and evaluation as its phases.

*Planning.* This stage begins with preliminary planning and envisioning an idea by drawing on previous work to model the prototype and the problem to be solved. After the first planning is finished, the planning will be finalized in terms of tools, cost analysis, design, benefits, and target groups. This will go through this step again if the device goes through another cycle for additional planning when the previous assessment was insufficient.

*Analysis*. This section wraps up the study's documentation from previous studies, technical requirements, and data from project models that meet the project's needs.

*Implementing.* This stage will begin developing the initial features of the previous design's given requirements, and it will repeat if the device goes through another cycle for a new set of specified characteristics.

*Testing*. After the development is complete and done, this test will confirm that the software is error-free, the hardware has no defects, and can perform well before being evaluated.

*Evaluation.* During this phase, it will be determined whether the device's design already strives to meet the project's requirements. As a result, the iteration will be compared to the study's specifications, or the documentation utilized to build the prototype.

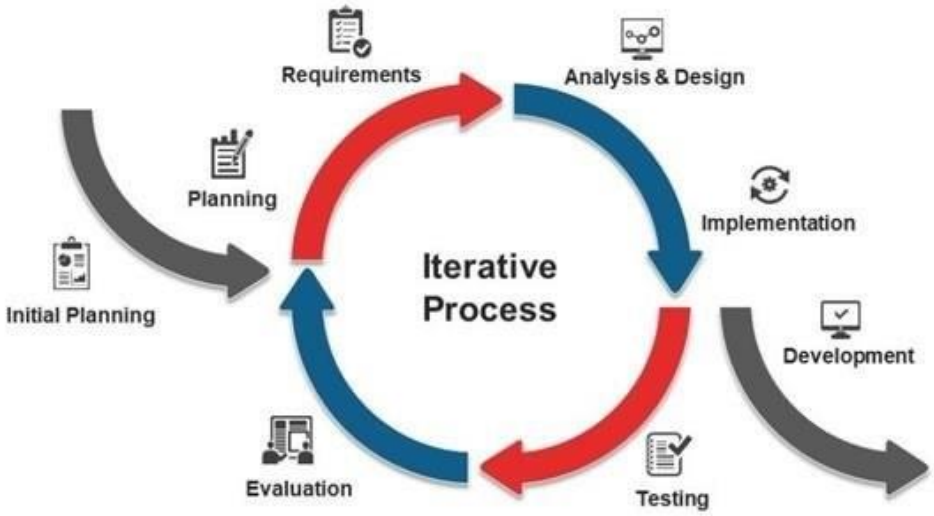


*Figure 9. Iterative Model*

**Research Locale**

The developers will conduct this research study at Malayan Colleges of Mindanao, Davao City, Davao Region, lying at the southeastern corner of the

Philippines. It is Mindanao's most populous city and the Philippines' third largest. It is well-known for its rapidly growing economic activities, urban development, and modern amenities. Davao city is also known for having the best nightclub, many party-goers from other places love the nightlife in Davao city. And that is why the developers conducted this study here to promote more safety from all the people who go to clubs, especially women from being drugged by sexual predators. The Roofies Detecting Cup SMS Device that detects date rape drugs will be useful to all establishments that sell alcoholic beverages to improve the safety of the customers. It is also evident that the people who go to nightclubs regularly would greatly benefit from this project.

**Research Respondents**

The respondents of this research will be adults, who are legally allowed to drink in bars and other drinking establishments, specifically those in the age group of 20 years old and above. The sample size would be a total of 80 respondents. Stratified random sampling will be then utilized in determining the research respondents, in which the entire population will be divided into a number of mutually exclusive and exhaustive groups which are called strata. This method will present that the sample can represent a given population, with respect to the characteristics of the study (Arnab, 2017).

The research participants will be selected through the following criteria:

A. Must be an adult aged from 20-40

B. Must be going to bars or other drinking establishments

C. Voluntarily participated in the research study

| Personal Data | Age group | Number of Males | Number of Females | Total number | Percentage Distribution |
|---|---|---|---|---|---|
| Davao City Residents | 21-25 | 10 | 10 | 20 | 25% |
| | 26-30 | 10 | 10 | 20 | 25% |
| | 31-35 | 10 | 10 | 20 | 25% |
| | 36-40 | 10 | 10 | 20 | 25% |

*Figure 10. Number of Participants*

**Research Assessment Tool**

This research will be utilizing the FURPS+ model as the research assessment tool. The term FURPS is an acronym for Functionality, Usability, Reliability, Performance, and Supportability. As for the "+" sign, it is to signify those constraints of the study. Those constraints may be design, implementation, interface, and physical constraints (COEPD, 2014). The FURPS model covers both the functional and non-functional requirements, focusing on both the qualities of the product and how well the final product would/might perform. This model is now the most common tool for research assessment and is widely used in the software industry (Quality Management, 2018). According to the statements in each subscale, the respondents in this survey will be asked to decide whether the project is bad (1), fair (2), good (3), very good (4), or outstanding (5). The questionnaire will be evaluated to ensure that the researchers are asking questions that quantify the product's non-functional and functional needs.

| INDICATORS | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Functionality** | | | | | |
| Ability to send the SMS directly from the device. | | | | | |
| Ability to detect any date rape drugs from any drink. | | | | | |
| **Usability** | | | | | |
| Easy to use as an ordinary drinking utensil. | | | | | |
| Responsiveness of the product is kept consistent through multiple usage. | | | | | |
| **Reliability** | | | | | |
| Failure did not hinder the product's activity. | | | | | |
| Obtains its reliability during the detection process. | | | | | |
| **Performance** | | | | | |
| The reagent immediately reacts when in contact with the drug in a spiked drink. | | | | | |
| Process performs flawlessly without any complications. | | | | | |
| **Supportability** | | | | | |
| Allows easy repairment and modified adjustments while still keeping its function. | | | | | |
| The product is efficient and can be adapted in many locations and situations. | | | | | |

**System Development Tools**

This capstone research study will make use of nine development tools to help the process of creating the project system. The system development tools the developers will use are the following: The Zimmermann Reagent, push-button, SMS, wax lining, NFC tag, NFC Tools, cobalt thiocyanate, and bromocresol green. Each developmental tool will play a significant role in designing and making the system. The table below explains the use of each development tool regarding its purpose in the study.

| Development Tool | Description | Function |
|---|---|---|
| Zimmermann Reagent | In chromatography, it is used as a quick spot-test to presumptively detect alkaloids, particularly benzodiazepines, as well as other chemicals. As a result, it's employed in drug testing. | This reagent will serve its purpose by functioning as a detector for rohypnol (flunitrazepam) and ketamine in beverages. |
| Push-button | It is a type of control switch appliance that is frequently used to turn on and off the control circuit. It's utilized to provide manual control signals to contactors, relays, and electromagnetic starters in electrical automated control circuits. | To send an alert to the beverage establishment, the consumer must press a push-button below the cup so the establishment can be locked down and the culprit will be found. |
| SMS | Stands for "Short Message Service," and it is a text messaging service that is used to transmit text messages to mobile phones. Messages can normally be up to 160 characters long, while some services enable 224 characters in a 5-bit format. | To inform the beverage establishment that their customer is being victimized with date-rape drugs, the device will send an SMS to the establishment. |
| Polyethylene wax | Polyethylene wax is polyethylene with a very low molecular weight that is made up of ethylene monomer chains. It is primarily available as a by-product of the polymerization of crude oil cracking into ethylene, where it is classified as LDPE wax or HDPE wax, and then further modified with specific required values, including oxidized waxes. | To keep the reactants from immediately detecting the date-rape drugs and contaminating the drink, a wax lining must be put on the cup and if the consumer wants to test if his/her drink is drugged, he/she can scratch the wax lining and expose the reactants to the beverage. |
| NFC Tag | Stands for Near-field communication, it is a technology that allows phones, tablets, laptops, and other | In order to know which consumer has alerted the establishment, each cup will be placed with an NFC tag so |

| | | |
|---|---|---|
| | devices to instantly be capable of delivering with other NFC-enabled devices. Radio-frequency identification (RFID) technology arose to it. | it has an ID that can be distinguished from other cups. The bartender will first scan the NFC and keeps note of the time the drink has been given. |
| NFC Tools | A free tool that lets you read, write, and program tasks on NFC tags and other NFC chips. NFC Tools is a simple and straightforward way to record standard information on your NFC tags that will work with any NFC device. | To scan the NFC ID of the cup, NFC Tools will be used to identify the ID of the cup. |
| Cobalt thiocyanate | An inorganic molecule with a multilayer coordination complex and its trihydrate is used to detect cocaine. The cobalt thiocyanate test (or Scott test) has resulted in a large number of false positives and convictions. | This chemical will be used to detect ketamine, a date-rape drug, in beverages. |
| Bromocresol green | A triphenylmethane dye that belongs to the triphenylmethane family of dyes (triarylmethane dyes). It belongs to the sulfonephthalein dye family, and it's employed as a pH indicator in things like microbe growth media and titrations. It is extensively used as a diagnostic method in clinical practice. | It will allow us to detect gamma-hydroxybutyrate (GHB), a date-rape drug, in beverages. |

*Table 2. System Development Tools*

The developers will utilize the following tools listed above to design a roofie detecting cup with an SMS device that alerts the beverage establishment. Each development tool is vital to the study and will be used to its utmost capacity by the researchers.

In chromatography, Zimmerman reagent is used as a quick spot-test to presumptively detect alkaloids, particularly benzodiazepines, as well as other chemicals. As a result, it's employed in drug testing. This reagent will serve its purpose by functioning as a detector for rohypnol (flunitrazepam) and ketamine in beverages.

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SMS stands for "Short Message Service," and it is a text messaging service that is used to transmit text messages to mobile phones. Messages can normally be up to 160 characters long, while some services enable 224 characters in a 5-bit format. To inform the beverage establishment that their customer is being victimized with date-rape drugs, the device will send an SMS to the establishment.

Polyethylene wax is polyethylene with a very low molecular weight that is made up of ethylene monomer chains. It is primarily available as a by-product of

the polymerization of crude oil cracking into ethylene, where it is classified as LDPE wax or HDPE wax, and then further modified with specific required values, including oxidized waxes. To keep the reactants from immediately detecting the date-rape drugs and contaminating the drink, a wax lining must be put on the cup and if the consumer wants to test if his/her drink is drugged, he/she can scratch the wax lining and expose the reactants to the beverage.

NFC stands for Near-field communication, it is a technology that allows phones, tablets, laptops, and other devices to instantly be capable of delivering with other NFC-enabled devices. Radio-frequency identification (RFID) technology arose to it. In order to know which consumer has alerted the establishment, each cup will be placed with an NFC tag so it has an ID that can be distinguished from other cups. The bartender will first scan the NFC and keeps note of the time the drink has been given.

NFC Tools is a free tool that lets you read, write, and program tasks on NFC tags and other NFC chips. NFC Tools is a simple and straightforward way to record standard information on your NFC tags that will work with any NFC device. To scan the NFC ID of the cup, NFC Tools will be used to identify the ID of the cup.

**Data Collection Procedure**

After performing the alpha testing, the researchers will conduct a survey with the utilization of Google Forms as the researchers' assessment tool. Google form links will be sent to the selected respondents of the capstone project.

Moreover, the questions in the survey are thoroughly formulated by the researchers. After the completion of beta testing, the researchers will then securely and confidentially gather the responses obtained from the questionnaires prepared by the researchers.

*Before Collection*

To be able to start the data collection, the researchers will be requesting a permit from the principal of their educational institution that will allow them to conduct the data collection. After being permitted by the educational institution, the researchers will then select the respondents that will be participating in the survey. Given that the respondents are adults, parental consent is not required. Nonetheless, the respondent's consent to participate will still be asked before the data collection starts.

*During the collection*

The researchers will select the respondents under a criterion. If the individual chosen is willing to participate, then he/she will be considered as a respondent of the study. The respondents will be informed of how their responses are obtained and stored. After the quick introduction to the respondents, the researchers will then email the Google Form Link, containing the questionnaires, and the date when the survey should be taken, to the respondents to their respective E-mail. Furthermore, if the respondents have any concerns or questions regarding the procedure, the researchers will provide an E-mail and contact

number for them to reach out to. The gathering of information is also facilitated by the researchers to ensure the confidentiality of the responses.

*After Collection*

After the researchers obtain the data from the alpha and beta testing, then the researchers will interpret the data gathered from the respondents. Through assessing the responses gathered, the researchers will be able to determine what parts of the study need improvement, as this is the last round of testing. Furthermore, changes regarding the design of the product may be considered before its deployment. This test seeks to define the possible FURPS problems on the design through the evaluation of the data with the use of weighted mean.

## Trustworthiness of the Study

*Internal Validity.* The internal validity of research is defined as the degree to which the observed results accurately reflect the truth in the population being studied and are free of methodological mistakes. Internal validity also means that the project can rule out other possible causes for a result. The developers will guarantee rigorous project planning and proper quality control and execution tactics, such as acceptable requirement methodologies, data gathering and analysis, and sample size, to assure the project's internal validity. To ensure validity, the developers will address dangers or flaws in the systems throughout the design and planning stages. The creators will also use a random selection and study technique for the respondents.

*External Validity.* This refers to the project's potential to be generalized outside the scope of the research. To ensure external validity, the developers will broaden the inclusion criteria so that the project's outcome is more realistic. In addition, reprocessing or calibration using statistical approaches will be used to correct concerns with external validity. In addition, the engineers will collect data in a variety of public areas in order to simulate a natural situation.

*Reliability.* The constancy of measurement is referred to as reliability. When completing a measurable assessment, a respondent should have roughly the same replies each time the exam is completed.

*Objectivity.* The premise of objectivity is that truth or an independent reality exists outside of perception. The developers will keep their distance from the project's research findings and guarantee that the data obtained is not dependent on their own beliefs. To maintain neutrality, the developers will focus on facts and data acquired, with interpretation based on real data. Furthermore, the developers will guarantee that they have no influence on the outcome, ensuring that the data is correctly interpreted.

## Ethical Consideration

The developers will always preserve the privacy of the individual and, as stated in the informed consent, will thoroughly verify their security. It will be extensively studied while maintaining identification and anonymity. When dealing with individuals on a social level, the developers will take all of the data into

account, with a focus on openness, fairness, privacy, confidentiality, and safety. Nothing will be directly related to the tester's name, or the response information will be shared with others. They have the right to alter their minds and withdraw from the study if they no longer choose to participate.

*Transparency.* Implies being truthful and open in your dealings. When dealing with sensitive facts, developers must know when to draw the line. Being truthful to oneself about one's activities is what transparency entails. Transparency also refers to the developers being open and honest about their actions and whether they are in line with their ideals.

*Justice*. The concept of justice can be characterized as the ethical need to equitably distribute the costs and benefits of research. Developers must not exploit the vulnerable, nor should they reject people who want to benefit from project testers for a good purpose.

*Informed Consent*. It is a basic concept in one of the ethical principles. After receiving all necessary information, human volunteers should join the research willingly (voluntarily). Before doing so, give them information about what it contains and get their consent. Therefore, users are given the flexibility to choose and answer questions at their leisure, as well as to provide information peacefully using Google forms.

*Social Value.* This capstone project goes to great lengths to ensure that the testers' experiences are fully safe. Because no direct benefits are predicted in testers, the benefits portion of the risk analysis is explored. The word "social

meaning" is intrinsically ambiguous, and it is used in numerous contexts. In the literature on research ethics.

*Privacy and Confidentiality*. It is a principle in ethical rules that everyone engaging in human subject research has privacy rights for research responders. In some cases, a researcher is aware of a study tester's identity but takes precautions to prevent the information from being shared with others. Topic confidentiality is not as frequent in human research as in other disciplines since most human research needs documented verification of agreement.

*Risk, Benefits, and Safety*. Throughout the project design and ethical evaluation, the safety of testers is clearly emphasized. The developers are responsible for identifying potential dangers and calculating their probability of occurrence. As a result, they will ensure the testers' safety and well-being during the project's development.

*Qualification of the Developers.* The capstone project will be reviewed, suggestions will be made, and consultations will be held, as well as a complete evaluation of the contents by capstone research examiners. As a result, the developers will provide the appropriate approval documents and paperwork as proof that the capstone project at Malayan Colleges of Mindanao in Davao City is nearing completion.

*Adequacy of Facilities.* The Malayan Colleges of Mindanao is one of the most prestigious and modernized universities in the Philippines. It can suffice the

resources for our study as its facilities and equipment are more than enough for our capstone project.

*Community Involvement*. This capstone project ensures no local customs, history, or people will be harmed or jeopardized. Instead, the initiative will be made public for scholarly reasons and for the benefit of society. It will be presented at conferences on education and economic migration, with a concentration on Science and Technology.

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